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THE RATE OF ACCUMULATION OF CONTEMPORARY MARINE DEPOSITS

V. N. Saks

Much objective information has been recently accumulated on the present rate of sediment formation in seas. Maps showing the rate of accumulation of deposits in the Black Sea have been drawn up by A. D. Arkhangel'skiy and N. M. Strakhov. Hydrogen sulfide contamination in the Black Sea and the resulting absence of bathyplankton below 200 m accounts for the maintenance of seasonal microstratification in the deep-water sediment. Terrigenous material borne by rivers in high water is deposited in summer; in fall the mass destruction of plankton organisms occurs and organic material is deposited; in winter bacterial processes develop in the hydrogen sulfide zone and calcium carbonate is deposited. The microlayer formed is not very thick; e.g., 30 to 100 yearly series can be counted in a microlayer 1 m thick. These conditions do not exist in most other seas; normally, bathyplankton eat silt in masses, mix it, and completely eliminate traces of seasonal changes under deposit-formation conditions. Arkhangel'skiy and Strakhov showed that the rate of formation of sedimentary rock on the bottom of the Black Sea varies from 0.6-3 cm to 20-30 cm every thousand years.

M. V. Klenova's studies of the Caspian Sea showed that the rate of formation of deposits in the northern part is about one millimeter per year, i.e., about 30 cm of dry silt every thousand years. In the Volga delta, according to B. A. Apollov, 0.5-7 cm of silt are deposited yearly. S. V. Bruyevich, using the absolute values of carbonates entering the Caspian Sea and their percentage content in deposits, calculated the average rates of deposit accumulation. A layer of dry limestone silt 10-12 cm thick is deposited in the southern part of the sea in the deep-water depression and in its eastern slope over a period of a thousand years. The corresponding figure for the northern part is 16-18 cm. In Kaydak Bay, the rate of accumulation of dry silt reaches a limit of 84 cm in a thousand years, compared with an average of 40 cm per thousand years. This data for the southern part of the sea was supplemented by A. F. Nosov's calculations of yearly layers. It turned out that up to 30 cm of dry silt is deposited per thousand years on the western slope of the Southern Caspian depression, up to 15-20 cm on the bottom of the depression, and about 10 cm on the eastern slope.

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According to V. P. Zenkovich's observations, a layer of silt 0.5 to 2.5 cm thick forms each year in the Aral Sea close to the deltas of the Amu-Dar'ya and Syr-Dar'ya. Far from the deltas of large rivers, according to Zenkovich, 1.5 to 2 mm of silt are accumulated each year. In the central part of the sea, where no currents flow, limestone silts are deposited at the rate of 0.1-0.2 mm per year (10 cm in a thousand years). S. V. Bruyevich determined from yearly layers the rate of accumulation of solid material in the western part of the Aral Sea as 18 cm in a thousand years.

The change of contemporary deposits with depth, according to M. V. Klenova, is a criterion for establishing the rate of deposit formation in the Barents Sea. Klenova used this change to calculate that dry substance is being deposited at a very slow rate (from 0.3 to 1.5 cm per thousand years) in the Barents Sea.

M. M. Yermolayev and L. M. Kurbatov established by the radium content the rate of deposit formation for the northern part of the Kara Sea. This method, first used by Soviet scientists in 1936, is based on the fact that radium entering into sedimentaion from sea water gradually disintegrates and its content decreases downward along the core column (after 10,000 years, only 2% of the initial radium content remains). From the above, L. M. Kurbatov and V. A. Yegorov established that the manganese concentrations which now lie on the bottom of the Kara Sea have formed over a period of 5,300-5,500 years. Kurbatov and Yermolayev found in 1937 that the rate of accumulation of sediments in the deep-water depressions of the northern Kara Sea was 20 cm per thousand years. In a recent work, the latter introduced a correction for the migration of radium within the silt, after which he obtained a rate of 0.051 ± 0.004 mm per year (6 cm per thousand years or about 2 cm per thousand years with a correction for water loss).

Because of the rapid decrease in radium content with time, this method can be used only for calculating the age of the more recent sediments, i.e., those deposited not over 10,000 years ago. The extremely accurate radium determination necessary for the more ancient layers is at present, unattainable. However, use is made of the fact that radium enters the sediments not only directly but also as a product of the decay of other radioactive elements. Uranium and thorium, which decay very slowly, give a practically constant amount of radium as a product of their decay. Ionium, a thorium isotope, which itself is a product of uranium decay, decays considerably faster. The half-line of radium is 1,690 years; ionium, 82,250 years; and uranium, 4.5 billion years. Thus the rate of deposition for periods of at least 300,000 years can be determined from the decrease in content of radium formed from ionium.

In the Greenland Sea and Arctic Ocean, brown silt is being replaced by gray silt at great depths, accompanied by the disappearance of formanifera, which are quite numerous in contemporary sedimentation. The upper layer is 2 to 20 centimeters thick. We can assume that the change of sedimentation is connected with the transition from the Ice Age -- with its lower water temperatures facilitating the dissolving of the limestone shells of formanifera -- to contemporary conditions.

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